TVP Stats Bulletin

U.S. DOE-EPRI Wind Turbine Verification Program

A joint program of the U.S. Department of Energy and the Electric Power Research Institute

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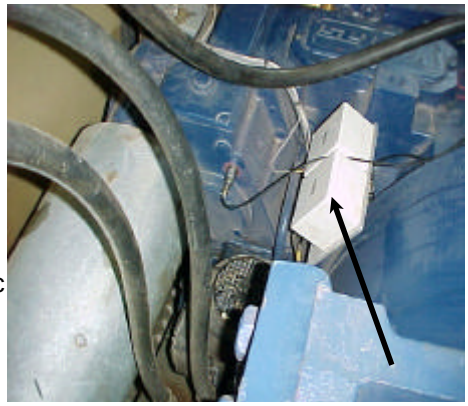
SWANTECH Visits Big Spring

In an effort to further optimize their operations and maintenance (O&M) program, the project operators at the Big Spring wind project have purchased a condition monitoring system for use at the site. The portable system, manufactured by SWANTECH, LLC, will be used to monitor turbines on a six-month basis. The operators hope that the use of mechanical condition monitoring equipment will help to identify bearing problems, particularly in the gearbox and generator, before more significant damage occurs. With early detection, it may be possible to take preventive measures and, as a result, reduce downtime and prevent subsequent damage to other turbine components.

The SWANTECH technology is based on acoustic measurements. Theory holds that mechanical defects in rotating machinery emit distinct bursts of acoustic energy as they are contacted. These acoustic emissions are recorded at a specific frequency (40 kHz) to filter out background noise and vibrations.



SWANTECH sensor on the gearbox

HOT LINKS

SWANTECH, LLC
www.swantech.com

Second Wind, Inc.
www.secondwind.com

The recordings can be analyzed with SWANTECH software in a number of ways to detect different types of problems.

At the request of the operators at Big Spring Wind Farm, SWANTECH, LLC, conducted an on-site demonstration of their mechanical monitoring equipment last summer. The demonstration took place on a Vestas V66 turbine. Eight sensors were installed, six on the gearbox and two on the generator. The sensor mounts were epoxied to the metal surface after preparation with a small grinder. Coaxial cables were run to a custom laptop computer. The turbine was run for approximately one hour and results were reviewed for another hour. Preliminary review did not indicate any serious problems.

The initial equipment cost for a portable monitoring computer and sensors is approximately $37,000. This includes a custom laptop computer, software, and several sensors. Training time is estimated to be 2-3 days. The time to conduct a test on a single turbine using the portable equipment is approximately 4 hours for two people.

The TVP plans to incorporate the data from and the experience with the condition monitoring system into the performance evaluation activities at the Big Spring project.

SCADA Installation & Performance Testing at TVA Wind Project

TVA's Buffalo Mountain wind project is finalizing plans to install a Second Wind SCADA system to support site operations and to facilitate data evaluation conducted under the TVP. The SCADA will allow remote monitoring of the three Vestas V47 turbines at the project and will collect data from the turbines, the meteorological tower on the adjacent hilltop, and a Second Wind Phaser power transducer to be installed at the project's substation.

Following installation of the SCADA system, the TVP is planning to conduct power performance testing at the Buffalo Mountain project. The Buffalo Mountain site poses a unique challenge for power performance testing, as the steep terrain surrounding the turbines causes installation of a meteorological tower upwind of the turbines to be infeasible. Consequently, completion of a power performance test following the IEC standard is not possible. Instead, TVP is planning to evaluate three alternative methods for completion of a power performance test. First, the turbines' nacelle anemometers will be used to estimate free-stream wind speed at the rotor using relationships observed for the Vestas V47 turbines at the Big Spring TVP project. Second, numerical wind flow modeling will be performed to derive correction factors to be applied to the wind speed measurements from a meteorological tower 300 meters northwest of the turbines. Finally, TVA's mobile SODAR unit will be used to take wind speed measurements from the site. The results of the power performance testing using these three methodologies will be compared. The conclusions and lessons learned from these tests should be useful for other wind projects looking to perform power performance tests where no meteorological tower is available.

In addition to power performance testing, the data generated by the Phaser will be used to evaluate power quality at the site. Details of the power quality testing will be determined shortly.

2nd Quarter 2002 *TVP STATS*

Kotzebue, AK: Kotzebue Electric Association

Turbine	Swept Area (m^2)	Apr-02 kWh	May-02 kWh	Jun-02 kWh	2nd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	176.7	9,733	10,927	4,502	25,163	17.5%	142.4	64,574
2	176.7	9,724	9,550	5,485	24,759	17.2%	140.1	60,567
3	176.7	8,225	9,563	6,866	24,655	17.1%	139.5	38,033
4	176.7	6,916	10,855	5,611	23,383	16.2%	132.3	62,622
5	176.7	7,723	9,149	5,802	22,675	15.7%	128.3	55,820
6	176.7	7,066	10,976	7,462	25,504	17.7%	144.3	65,568
7	176.7	10,249	11,135	7,107	28,491	19.8%	161.2	53,701
8	176.7	8,602	9,702	6,541	24,845	17.2%	140.6	58,349
9	176.7	10,412	9,799	7,284	27,496	19.1%	155.6	65,000
10	176.7	9,726	10,507	7,705	27,939	19.4%	158.1	70,392
Project Totals	1767.0	88,377	102,167	64,366	254,909	17.7%	144.3	594,625

Rating	66 kW	Apr-02 WS (m/s)	May-02 WS (m/s)	Jun-02 WS (m/s)	Qtr WS (m/s)
Mean hub height (26.5 m) WS		6.2	6.5	5.6	6.1

Buffalo Mountain, TN: Tennessee Valley Authority

Turbine	Swept Area (m^2)	Apr-02 kWh	May-02 kWh	Jun-02 kWh	2nd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	1,735.6	150,796	152,542	45,402	348,740	24.2%	200.9	852,824
2	1,735.6	139,911	141,987	49,317	331,215	23.0%	190.8	813,608
3	1,735.6	140,849	148,807	51,547	341,203	23.7%	196.6	821,831
Project Totals	5,206.9	431,556	443,336	146,266	1,021,158	23.6%	196.1	2,488,263

Rating	660 kW	Apr-02 WS (m/s)	May-02 WS (m/s)	Jun-02 WS (m/s)	Qtr WS (m/s)
Mean (50 m) WS		7.9	7.2	4.9	6.6

Algona, IA: Cedar Falls (primary owner), Algona Municipal Utilities (host)

Turbine	Swept Area (m^2)	Apr-02 kWh	May-02 kWh	Jun-02 kWh	2nd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	1,963.5	277,372	234,397	204,813	716,582	43.7%	365.0	1,498,014
2	1,963.5	272,182	233,169	203,588	708,939	43.3%	361.1	1,466,185
3	1,963.5	274,295	224,855	197,471	696,621	42.5%	354.8	1,431,427
Project Totals	5,890.5	823,849	692,421	605,872	2,122,142	43.2%	360.3	4,395,626

Rating	750 kW	Apr-02 WS (m/s)	May-02 WS (m/s)	Jun-02 WS (m/s)	Qtr WS (m/s)
Mean hub height (50 m) WS		9.0	8.2	8.1	8.4

Springview, NE: Nebraska Public Power District (primary owner), KBR (host)

Turbine	Swept Area (m^2)	Apr-02 kWh	May-02 kWh	Jun-02 kWh	2nd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	1,963.5	228,591	218,283	183,625	630,499	38.5%	321.1	1,376,057
2	1,963.5	201,134	221,964	207,249	630,347	38.5%	321.0	1,312,499
Project Totals	3,927.0	429,725	440,247	390,874	1,260,846	38.5%	321.1	2,688,556

Rating	750 kW	Apr-02 WS (m/s)	May-02 WS (m/s)	Jun-02 WS (m/s)	Qtr WS (m/s)
Mean hub height (65 m) WS		8.3	8.0	7.7	8.0

Glenmore, WI: Wisconsin Public Service

Turbine	Swept Area (m^2)	Apr-02 kWh	May-02 kWh	Jun-02 kWh	2nd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	1,661.9	133,383	114,015	37,519	284,918	21.7%	171.4	761,902
2	1,661.9	63,836	127,683	15,450	206,970	15.8%	124.5	638,666
Project Totals	3,323.8	197,219	241,698	52,970	491,887	18.8%	148.0	1,400,568

Rating	600 kW	Apr-02 WS (m/s)	May-02 WS (m/s)	Jun-02 WS (m/s)	Qtr WS (m/s)
Mean hub height (60 m) WS		7.2	6.9	5.7	6.6

3rd Quarter 2002 *TVP STATS*

Kotzebue, AK: Kotzebue Electric Association

Turbine	Swept Area (m^2)	Jul-02 kWh	Aug-02 kWh	Sep-02 kWh	3rd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	176.7	5,859	5,467	5,332	16,658	11.4%	94.3	81,232
2	176.7	5,402	4,987	5,667	16,055	11.0%	90.9	76,622
3	176.7	5,657	5,959	5,864	17,480	12.0%	98.9	55,512
4	176.7	1,316	5,239	5,661	12,215	8.4%	69.1	74,838
5	176.7	5,608	5,015	6,257	16,880	11.6%	95.5	72,700
6	176.7	5,934	6,221	6,390	18,545	12.7%	105.0	84,113
7	176.7	5,846	6,019	5,054	16,919	11.6%	95.7	70,619
8	176.7	5,487	5,639	5,267	16,393	11.2%	92.8	74,742
9	176.7	5,804	5,455	6,185	17,444	12.0%	98.7	82,444
10	176.7	1,279	6,722	6,591	14,592	10.0%	82.6	84,984
Project Totals	1767.0	48,191	56,722	58,268	163,181	11.2%	92.3	757,806

Rating	66 kW	Jul-02 WS (m/s)	Aug-02 WS (m/s)	Sep-02 WS (m/s)	Qtr WS (m/s)
Mean hub height (26.5 m) WS		5.3	5.6	4.9	5.3

Buffalo Mountain, TN: Tennessee Valley Authority

Turbine	Swept Area (m^2)	Jul-02 kWh	Aug-02 kWh	Sep-02 kWh	3rd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	1,735.6	24,745	47,373	67,349	139,467	9.6%	80.4	992,291
2	1,735.6	40,283	48,814	68,957	158,054	10.8%	91.1	971,662
3	1,735.6	40,633	50,547	63,848	155,028	10.6%	89.3	976,859
Project Totals	5,206.9	105,661	146,734	200,154	452,549	10.4%	86.9	2,940,812

Rating	660 kW	Jul-02 WS (m/s)	Aug-02 WS (m/s)	Sep-02 WS (m/s)	Qtr WS (m/s)
Mean (50 m) WS		4.4	4.7	5.8	5.0

Algona, IA: Cedar Falls (primary owner), Algona Municipal Utilities (host)

Turbine	Swept Area (m^2)	Jul-02 kWh	Aug-02 kWh	Sep-02 kWh	3rd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	1,963.5	107,196	113,913	133,295	354,404	21.4%	180.5	1,852,418
2	1,963.5	100,073	111,093	128,961	340,127	20.5%	173.2	1,806,312
3	1,963.5	92,081	98,667	122,332	313,080	18.9%	159.5	1,744,507
Project Totals	5,890.5	299,350	323,673	384,588	1,007,611	20.3%	171.1	5,403,237

Rating	750 kW	Jul-02 WS (m/s)	Aug-02 WS (m/s)	Sep-02 WS (m/s)	Qtr WS (m/s)
Mean hub height (50 m) WS		5.7	6.0	6.6	6.1

Springview, NE: Nebraska Public Power District (primary owner), KBR (host)

Turbine	Swept Area (m^2)	Jul-02 kWh	Aug-02 kWh	Sep-02 kWh	3rd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	1,963.5	190,295	212,422	245,822	648,539	39.2%	330.3	2,024,596
2	1,963.5	197,915	217,077	244,515	659,507	39.8%	335.9	1,972,006
Project Totals	3,927.0	388,210	429,499	490,337	1,308,046	39.5%	333.1	3,996,602

Rating	750 kW	Jul-02 WS (m/s)	Aug-02 WS (m/s)	Sep-02 WS (m/s)	Qtr WS (m/s)
Mean hub height (65 m) WS		7.4	7.5	8.0	7.6

Glenmore, WI: Wisconsin Public Service

Turbine	Swept Area (m^2)	Jul-02 kWh	Aug-02 kWh	Sep-02 kWh	3rd Qtr-02 kWh	Quarter CF	Qtr kWh/m^2	YTD kWh
1	1,661.9	9,594	40,783	84,378	134,755	10.2%	81.1	896,657
2	1,661.9	43,188	27,415	76,387	146,990	11.1%	88.4	785,656
Project Totals	3,323.8	52,782	68,198	160,765	281,745	10.6%	84.8	1,682,313

Rating	600 kW	Jul-02 WS (m/s)	Aug-02 WS (m/s)	Sep-02 WS (m/s)	Qtr WS (m/s)
Mean hub height (60 m) WS		5.7	5.2	6.5	5.8

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